

The Occurrence of Babingtonite in Spilite from Three Kings Islands

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Abstract

The paper records the occurrence and optical properties of the rare mineral babingtonite in spilite. Comparison is made with other parageneses of this mineral.

In his account of spilite and keratophyre from Three Kings Islands, northern New Zealand, the late Professor J. A. Bartrum described and figured an unidentified pyroxene-like mineral in the spilite (Bartrum, 1936, p. 420 and Pl. XI, 4). He noted its striking pleochroism, probable positive optical character and large optic axial angle, and inferred from its occurrence in short veinlets, its xenomorphism, and its relatively coarse crystallization, that it crystallized from a liquid enriched in volatiles. In a footnote (p. 420) he records that Dr. N. L. Bowen, to whom he showed the slide, suggested that the mineral might belong to the epidote group. A chemical analysis is given of the rock in which it occurs.

This mineral now proves to be the rare species *babingtonite*. In the course of a more extended study of the lavas of Great Island, Three Kings Group, Professor Bartrum's material has been re-examined and another occurrence of the mineral in spilite has been found.

The original occurrence was in spilitic pillow lava that "outcrops near sea-level in a band 40 feet thick . . . traceable in the sea-cliffs for about 200 yards" (Bartrum, 1936, p. 415). The outcrop is about a quarter of a mile west of the landing-place in North West Bay, Great Island, and is accessible only from a small boat (Bartrum, personal communication). In the original slide (No. 559 in the Auckland University College Collection), as recorded by Professor Bartrum, the mineral occurs in little veinlets and nests, in the form of anhedral crystals up to 0.25 mm. across, as well as in rare smaller crystals scattered through the rock. In the veinlets it is accompanied by quartz. In some cases, where veinlets cut the acicular augites characteristic of the rock, babingtonite replaces the augite prisms (fig. 1).

Amongst Bartrum's hand specimens are some with veins up to 1-cm. wide of white prehnite which enclose, parallel with their walls, strings of dark granules that prove also to be babingtonite.

Babingtonite also occurs in spilite outcropping in the prominent crag on the spur leading to Hapuka Point on Great Island (specimen 6203 in the Auckland Museum Collection). In this rock it forms small subhedral crystals, embedded in intersertal ferriferous chlorite (brunsvigite).

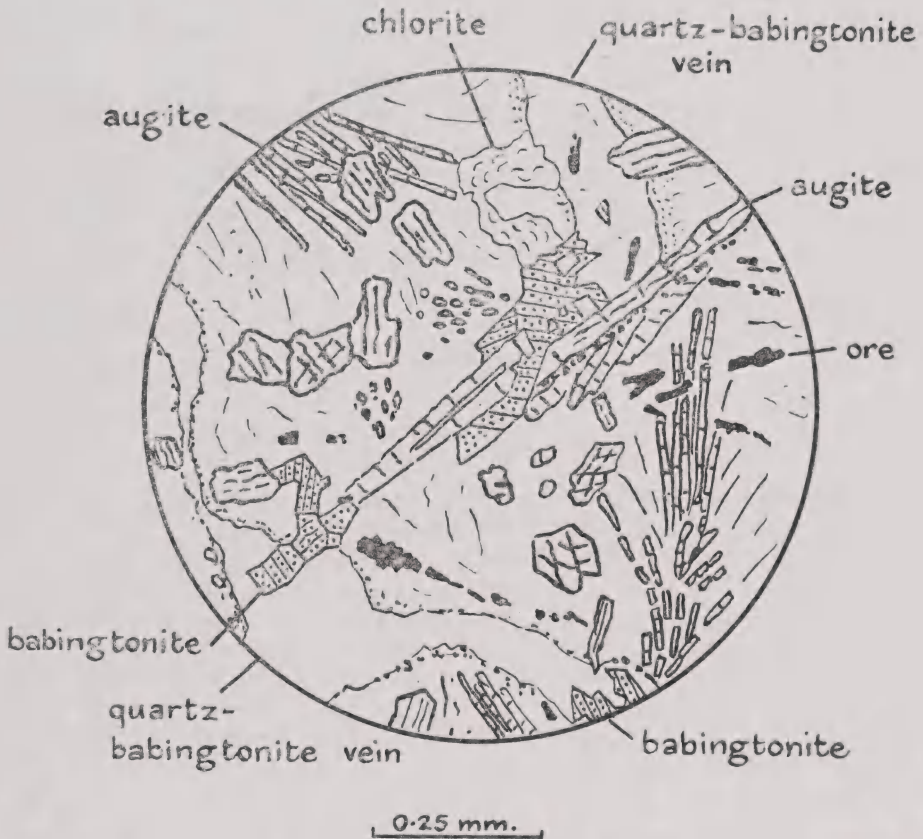


Fig. 1. Babingtonite in spilite (Slide No. 559, Auckland University College Collection).

The following optical properties were determined for the Great Island babingtonite:

n_X	1.713	\pm 0.003	X	bright green.
n_Y	1.724	\pm 0.003	Y	pale purple-brown.
n_Z	1.744	\pm 0.005	Z	strong purple-brown.
$2V_z$	80°, 85°, 86°.			

Dispersion $r > v$ distinct.

Extinction angle Z: cleavage (001) in sections normal to Y = 47°. One good cleavage is shown in sections normal to Y.

Comparative optical data are:

	Arendal and Arendal ¹ Somerville ¹	Baveno ¹	Yakuku ²	Woburn Mass. ³
n_X	1.717	1.713	1.715	1.720
n_Y	1.730	1.725	1.725	1.731
n_Z	1.752	1.746	1.740	1.753
$2V_z$	75° (calc.)			76° \pm 2°
	$r > v$ strong			

- (1) Washington and Merwin, 1923.
- (2) Watanabe, 1922.
- (3) Richmond, 1937.

Babingtonite is a mineral conspicuous for the constancy of its properties. It apparently does not admit extensive atomic substitutions, for a number of good analyses are published, all of which agree well. One, given by Palache and Fraprie (1902), which deviated somewhat from others, was later shown by Palache and Gonyer (1932) to be incorrect. The last-quoted authors assign to the mineral the formula $\text{Ca}_2 \text{Fe}^{\cdot\cdot} \text{Fe}^{\cdot\cdot} \text{Si}_5 \text{O}_{14} (\text{OH})$. The ratio of ferrous to ferric iron is near 1 : 1. Richmond (1937) shows that there are two of these formula units to the unit cell.

Various views on its relationships have been advanced and in the most recent study (Richmond, 1937) its relationship to rhodonite has been re-emphasized. It remains, however, an isolated mineral species.

Palache and Gonyer (1932) give a list of its parageneses in which they record four occurrences in veins or cavities in diabase, three in pegmatitic granites, a contact iron skarn, a granodiorite-slate and limestone contact and two veins in gneiss. From the present point of view the occurrences in diabase are of particular interest. In these cases it is found associated with prehnite, quartz, epidote, albite, chlorite, zeolites and calcite.

Secondary minerals formed in cavities, and partly from interstitial glass, in pillow lavas of the Watchung basalts of New Jersey were described by Fenner (1910). Amongst them was a mineral subsequently (Fenner, 1914) identified as babingtonite. Fenner made a careful analysis of the order of formation of the secondary minerals, and in his paragenetic scheme babingtonite enters with albite, quartz, actinolitic amphibole and garnet, immediately after the cessation of precipitation of labradorite, diopside and magnetite. The low temperature limit of its stability range is uncertain, since it was not separately identified in his first paper, but it clearly extends through that of prehnite, upon which it is sedentary in the New Zealand rock, while it was presumably a coprecipitate with ferriferous chlorite in the rock from Hapuka Point crag. This chlorite is uniformly distributed in intersertal position throughout the rock and there is no evidence that it has formed at the expense of any pre-existing mineral phase.

Since babingtonite is a mineral precipitating in the temperature stability field of pegmatites, its presence as a disseminated constituent in some spilites accords with the belief that crystallization of these rocks continued to temperatures much below those normal to extrusive rocks. It is not a mineral that would be produced by post-consolidation metamorphism of the rock, while the texture of specimen 6203 with its delicate cervicorn (and quite unaltered) augites is clearly magmatic. The mineralogy of the rock probably indicates that magmatic crystallization continued to the low temperatures at which babingtonite is stable. Final separation of residual fluids led to the formation of babingtonite-bearing prehnite veins.

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